

## CLAIMS

We claim:

1. A water decontamination process comprising the step of contacting water containing anionic contaminants, selected from the group consisting of species including chromium and species including arsenic, with sorbent material that binds anionic species predominantly through the formation of surface complexes, wherein said sorbent material comprises divalent metals, trivalent metals and species selected from the group consisting of oxygen and sulfur.
2. The process of claim 1 wherein the sorbent material comprises a chemical substance selected from the group consisting of a first composition in which a species A has a prevalence of about half that of a species B, and a species X has a prevalence of about four times that of the species A .  
wherein for either composition A and B are metal species and X is selected from the group consisting of oxygen and sulfur.
3. The process of claim 1 wherein the sorbent material comprises a chemical substance selected from the group consisting of  $MgAl_2O_4$ ,  $MnAl_2O_4$ ,  $FeAl_2O_4$ ,  $ZnAl_2O_4$ ,  $MgFe_2O_4$ ,  $MnFe_2O_4$ ,  $Fe_3O_4$ ,  $ZnFe_2O_4$ ,  $NiFe_2O_4$ ,  $CuFe_2O_4$ ,  $Fe_3S_4$ ,  $MgCr_2O_4$ ,  $(Mn,Fe)(Cr,V)_2O_4$ ,  $FeCr_2O_4$ ,  $(Ni,Fe)(Cr,V)_2O_4$ ,  $(Co,Ni)(Cr,Al)_2O_4$ ,  $MgV_2O_4$ ,  $FeV_2O_4$ ,  $(Mn,Fe)(V,Cr)_2O_4$ ,  $Mg_2TiO_4$ ,  $Fe_2TiO_4$ ,  $Mn_3O_4$ ,  $CuCo_2S_4$ ,  $CuBi_2O_4$ ,  $Mn(Mn,Fe)_2O_4$  and  $ZnMn_2O_4$ .
4. The process of claim 2 wherein the sorbent material comprises a chemical substance having the first composition, and A is selected from the group consisting of  $Co^{2+}$ ,  $Cu^{2+}$ ,  $Fe^{2+}$ ,  $Mg^{2+}$ ,  $Mn^{2+}$ ,  $Ni^{2+}$ ,  $Zn^{2+}$ , and combinations thereof, and B is selected from the group consisting of  $Al^{3+}$ ,  $Bi^{3+}$ ,  $Co^{3+}$ ,  $Cr^{3+}$ ,  $Fe^{3+}$ ,  $Mn^{3+}$ ,  $Ni^{3+}$ ,  $V^{3+}$  and combinations thereof.

5. A water decontamination medium comprising:

sorbent material that binds anionic species, selected from the group consisting of species including chromium and species including arsenic, predominantly through the formation of surface complexes, wherein said sorbent material comprises divalent metals, trivalent metals and a species selected from the group consisting of oxygen and sulfur.

6. The decontamination medium of claim 6 wherein the sorbent material comprises a chemical substance selected from the group consisting of

a first composition in which a species B has a prevalence of about twice that of a species A, and a species X has a prevalence of about four times that of the species A

wherein for either composition A and B are metal species and X is selected from the group consisting of oxygen and sulfur.

7. The decontamination medium of claim 6 wherein the sorbent material comprises a chemical substance selected from the group consisting of  $MgAl_2O_4$ ,  $MnAl_2O_4$ ,  $FeAl_2O_4$ ,  $ZnAl_2O_4$ ,  $MgFe_2O_4$ ,  $MnFe_2O_4$ ,  $Fe_3O_4$ ,  $ZnFe_2O_4$ ,  $NiFe_2O_4$ ,  $CuFe_2O_4$ ,  $Fe_3S_4$ ,  $MgCr_2O_4$ ,  $(Mn,Fe)(Cr,V)_2O_4$ ,  $FeCr_2O_4$ ,  $(Ni,Fe)(Cr,V)_2O_4$ ,  $(Co,Ni)(Cr,Al)_2O_4$ ,  $MgV_2O_4$ ,  $FeV_2O_4$ ,  $(Mn,Fe)(V,Cr)_2O_4$ ,  $Mg_2TiO_4$ ,  $Fe_2TiO_4$ ,  $Mn_3O_4$ ,  $CuCo_2S_4$ ,  $CuBi_2O_4$ ,  $Mn(Mn,Fe)_2O_4$  and  $ZnMn_2O_4$ .

8. The decontamination of claim 7 wherein the sorbent material comprises a chemical substance having the first composition, and A is selected from the group consisting of  $Co^{2+}$ ,  $Cu^{2+}$ ,  $Fe^{2+}$ ,  $Mg^{2+}$ ,  $Mn^{2+}$ ,  $Ni^{2+}$ ,  $Zn^{2+}$ , and combinations thereof, and B is selected from the group consisting of  $Al^{3+}$ ,  $Bi^{3+}$ ,  $Co^{3+}$ ,  $Cr^{3+}$ ,  $Fe^{3+}$ ,  $Mn^{3+}$ ,  $Ni^{3+}$ ,  $V^{3+}$  and combinations thereof.